

# Relationship of zooplankton emergence, manta ray abundance and SCUBA diver usage Kona Hawaii

By, Kara Osada  
UHH masters thesis

Tropical Conservation Biology and Environmental Science



What brings me here today

The Manta Rays!!!





- Manta ray dives contribute an estimated 2.4 million dollars to Kona's economy annually.
- The manta ray night dive depends on the zooplankton the manta rays come in to feed upon
- Held over a rubble/sand/coral area

# Manta Rays

- Little is known about manta rays but new research has found seasonal abundance increases of manta rays in association with high productivity areas (Dewar et al 2008; Luiz et al. 2009)
- In other words, areas of high food concentrations will have high manta ray numbers.
- Thus as manta rays are important economic benefit for Hawaii, knowing about and protecting their food source – zooplankton - seems key



# Reefs and Zooplankton

- In the past zooplankton were considered insignificant contributors to coral reef foodwebs (Odum and Odum, 1955; Trander and George, 1972; Johannes, 1974).
- More recent studies have demonstrated the importance of zooplankton to reef nutrition and idealized zooplankton as a source of increasing nutrient revenues for the reef ecosystem as a whole (Emery, 1968; Rothans and Miller, 1991; Pinnegar and Polunin, 2005)
- What we now understand is in many areas some zooplankton often thought to be oceanic in nature actually reside within the benthic community (Sale et al., 1976; Porter and Porter, 1977; Alldredge and King, 1977; Sale et al. 1978; Hobson and Chess 1979; Walter et al., 1981; Jacoby and Greenwood, 1989).

# Why does this matter for us?

- Manta rays come into the night dive area to feed on the zooplankton attracted to divers lights
- Zooplankton might be originating from the substrate the divers are sitting on
- This has larger implications...





# Diver sustainability

- Research has shown that if SCUBA diver numbers exceed 5,000 to 6,000 divers annual a reduction in coral growth is expected (Hawkins et al., 1997; Jameson et al., 1999; Tatalos and Austin, 2001; Zakai and Chadwick-Furman, 2002)
- Zooplankton research has found that increased emergence rates are found from increased substrate complexity - such as coral reef communities (Sale et al., 1976; Porter and Porter, 1977; Alldredge and King, 1977; Sale et al., 1978; Hobson and Chess, 1979 Walter et al., 1981; Jacoby and Greenwood, 1989).
- An estimated 20,000 to 25,000 divers dive on the dive site called Garden Eel Cove annual – the location of the manta ray night dive

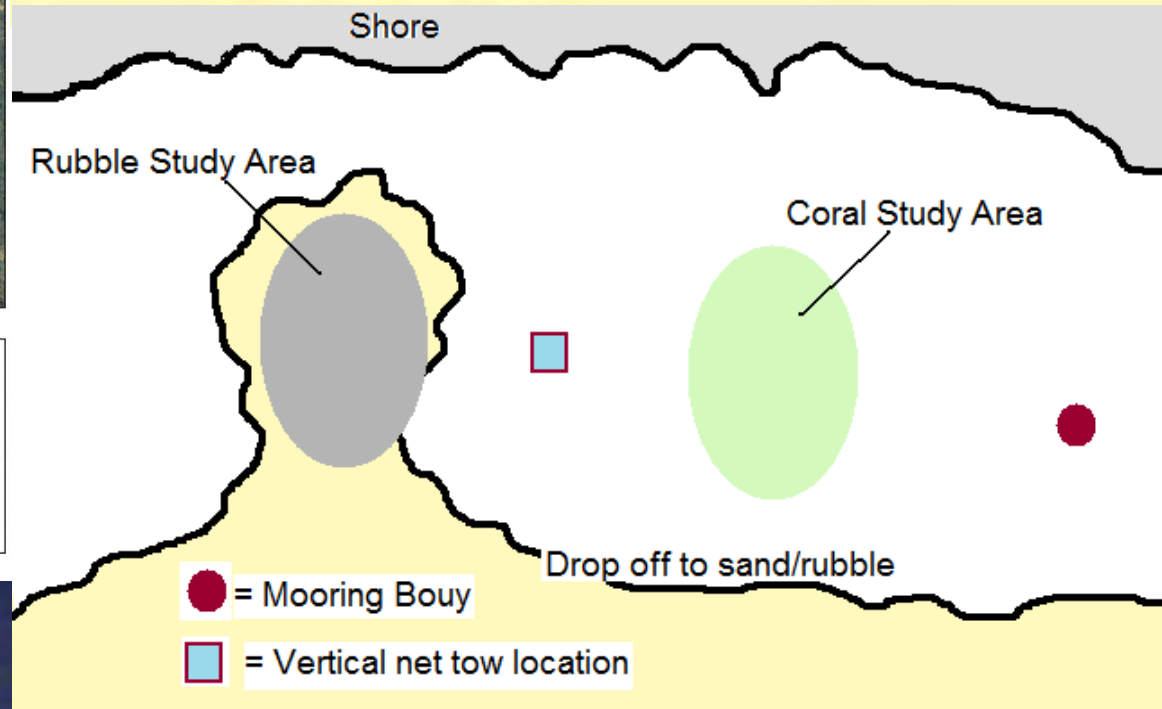
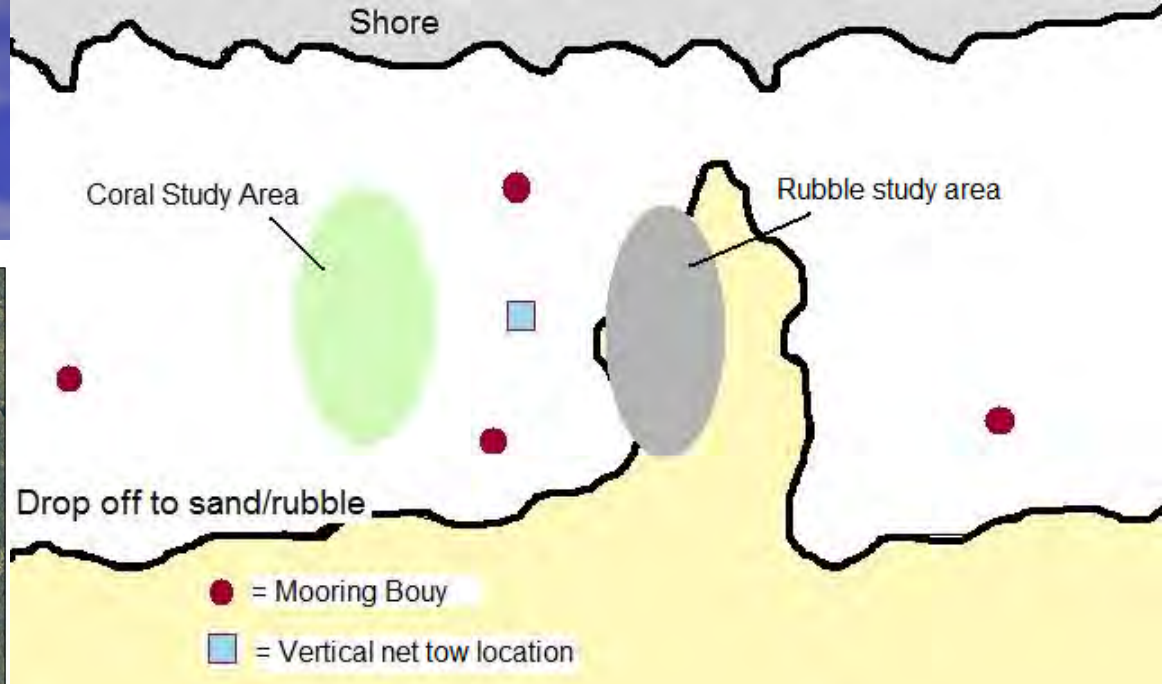
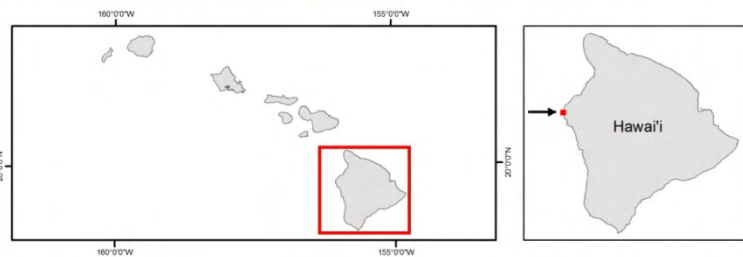
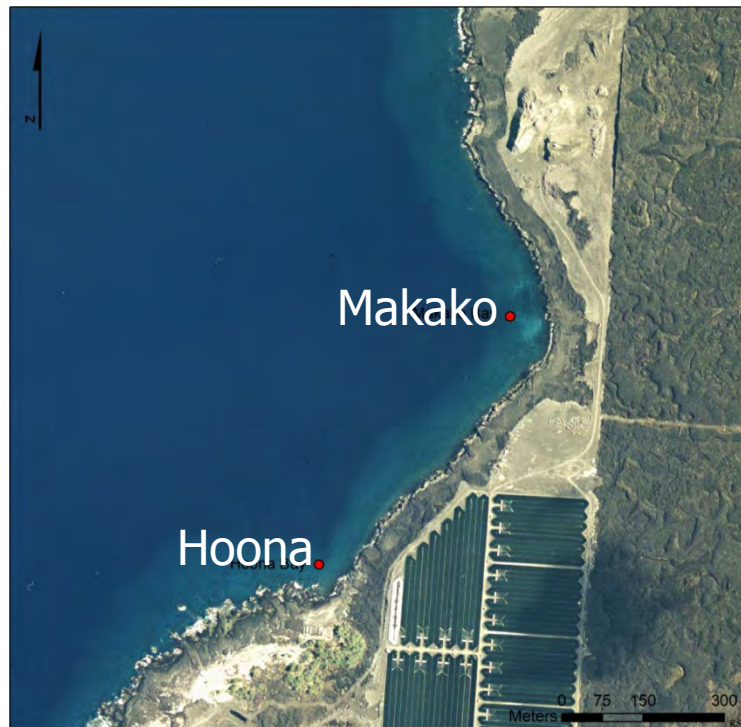
# Zooplankton

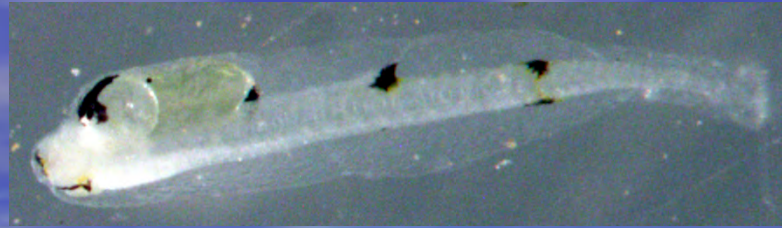
- Collected three ways
  - Emergence nets
  - Surface Tows
  - Vertical Tows



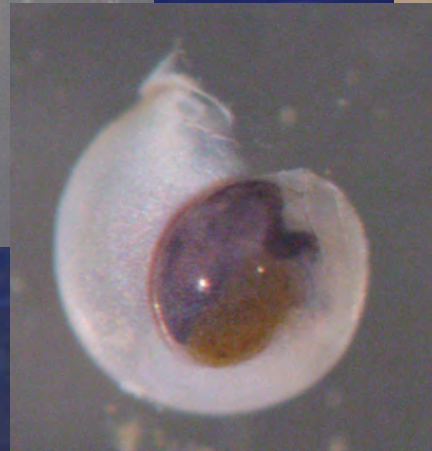


# Study sites



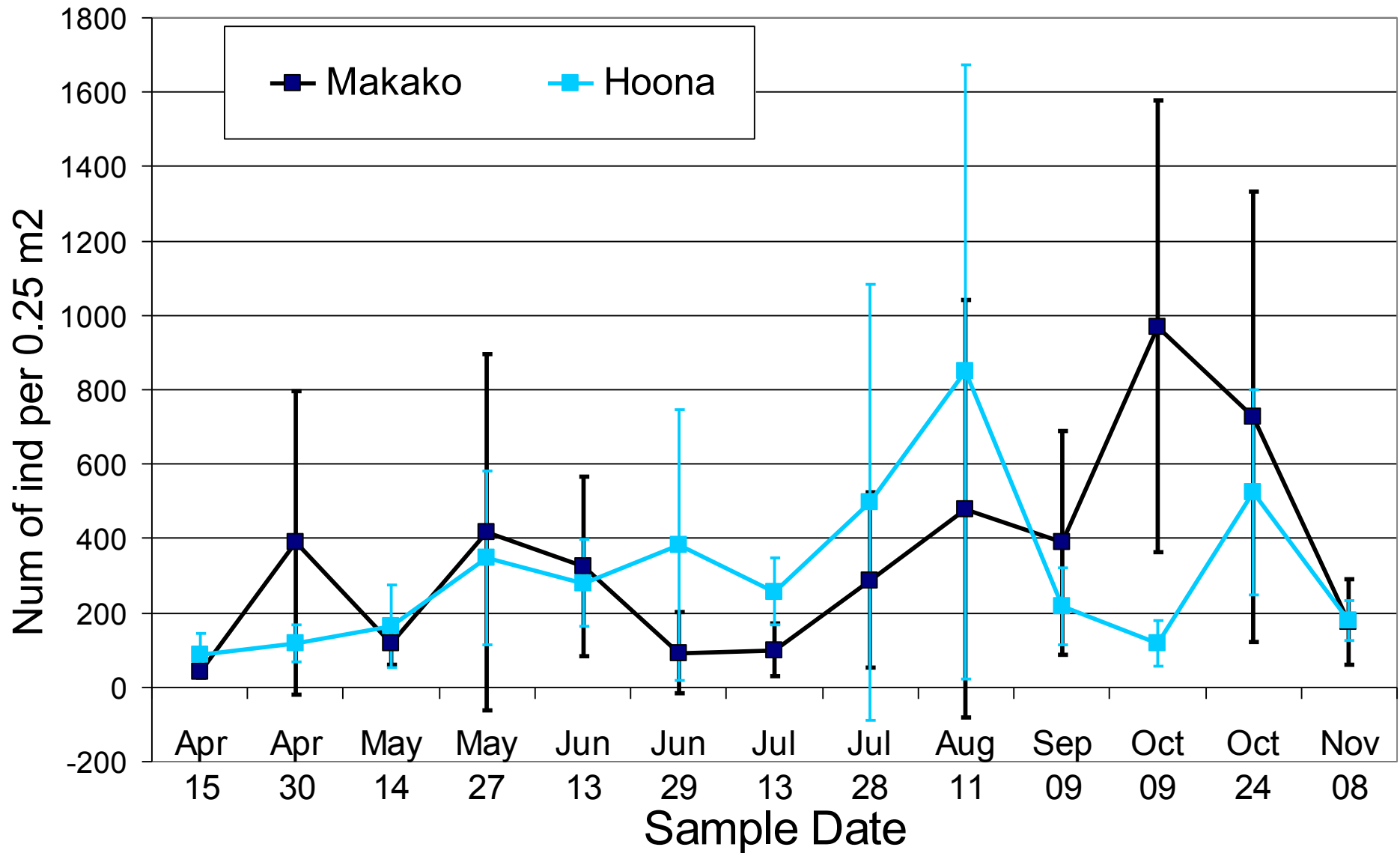


# Zooplankton

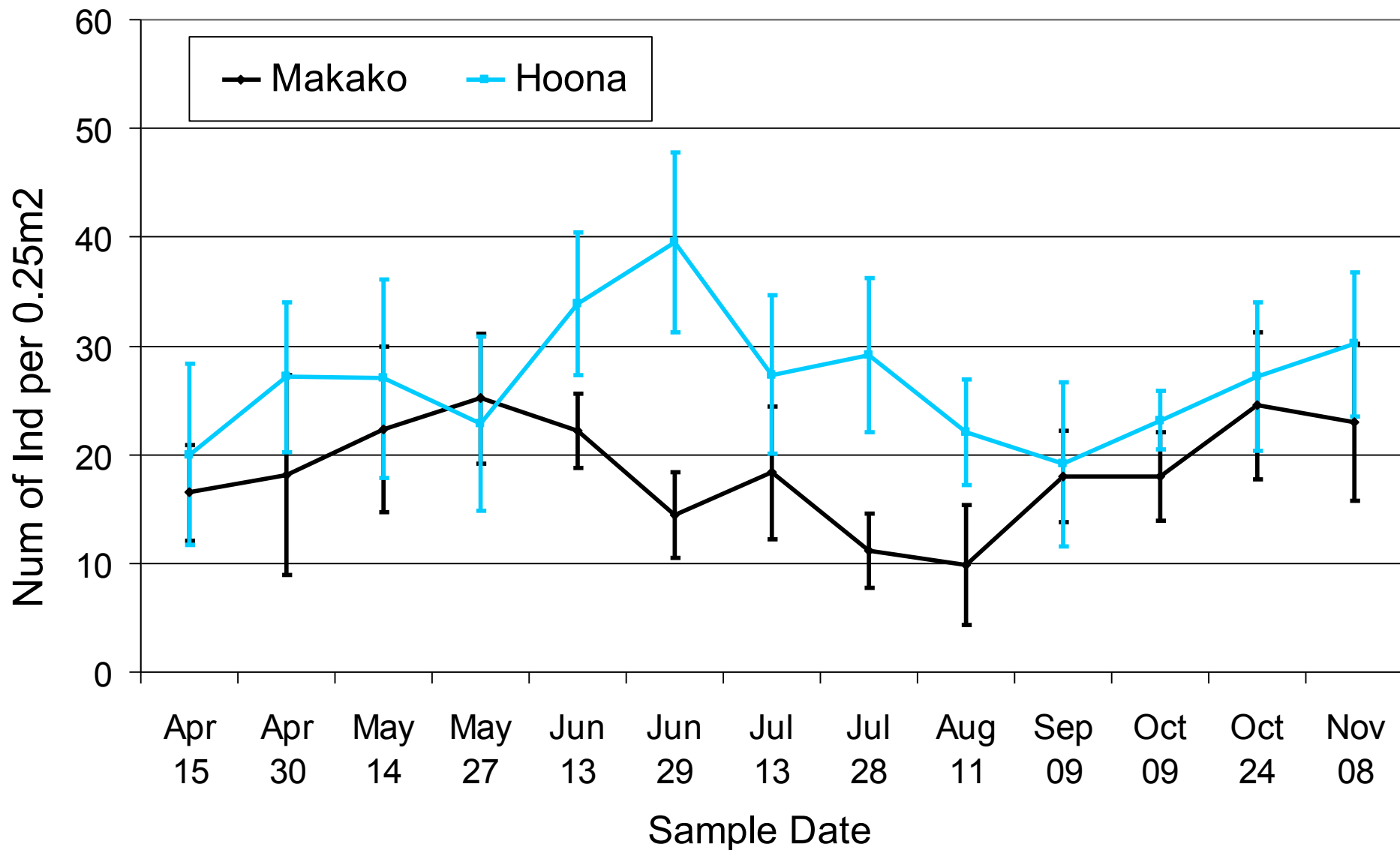




# Average ( $\pm$ SD) number of individual zooplankton



# Average ( $\pm$ SD) number of zooplankton species





# Most dominate species of zooplankton at night within Makako Bay



Female

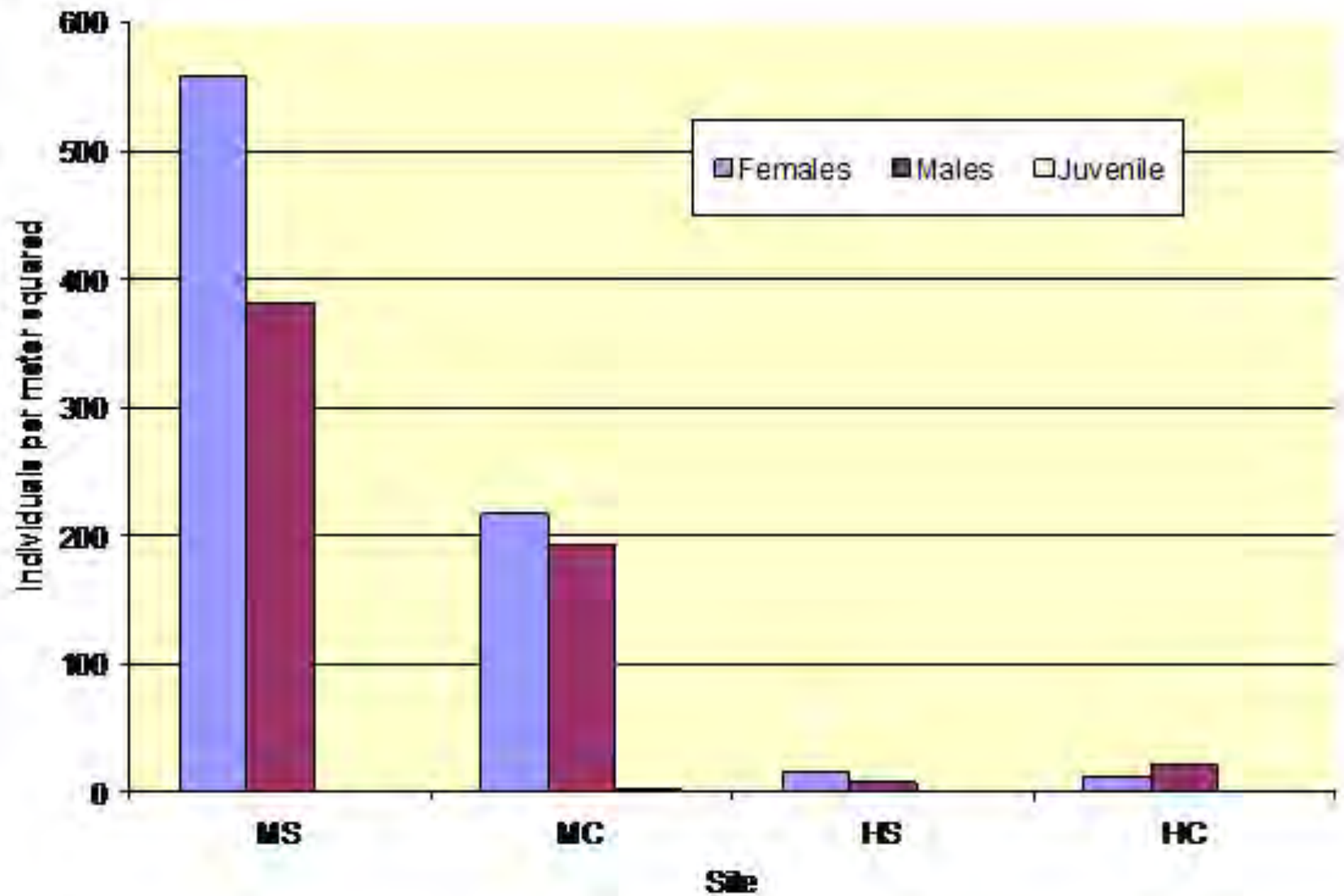


Male



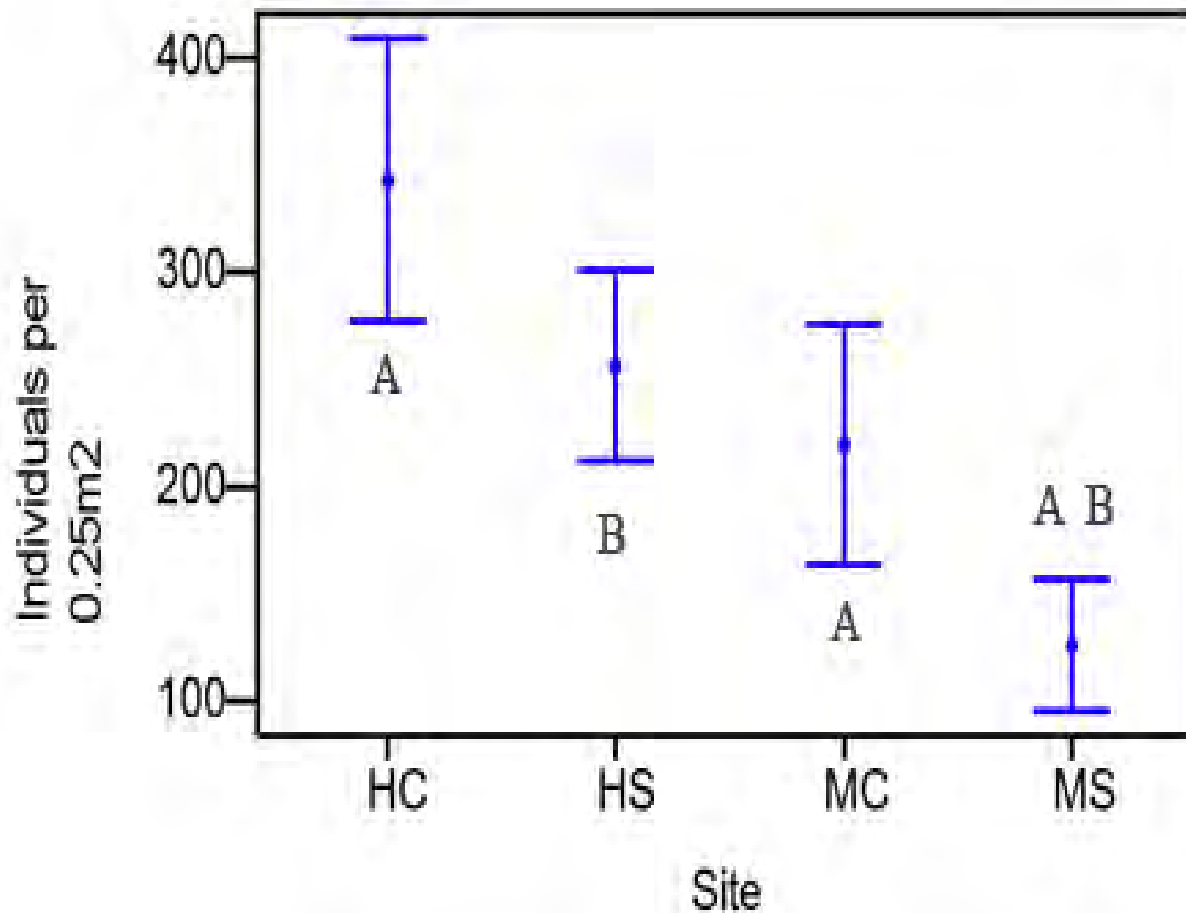
most likely *Labidocera madurae*

## *Labidocera* sp.





# Total zooplankton without *Labidocera*



# Surface Tows

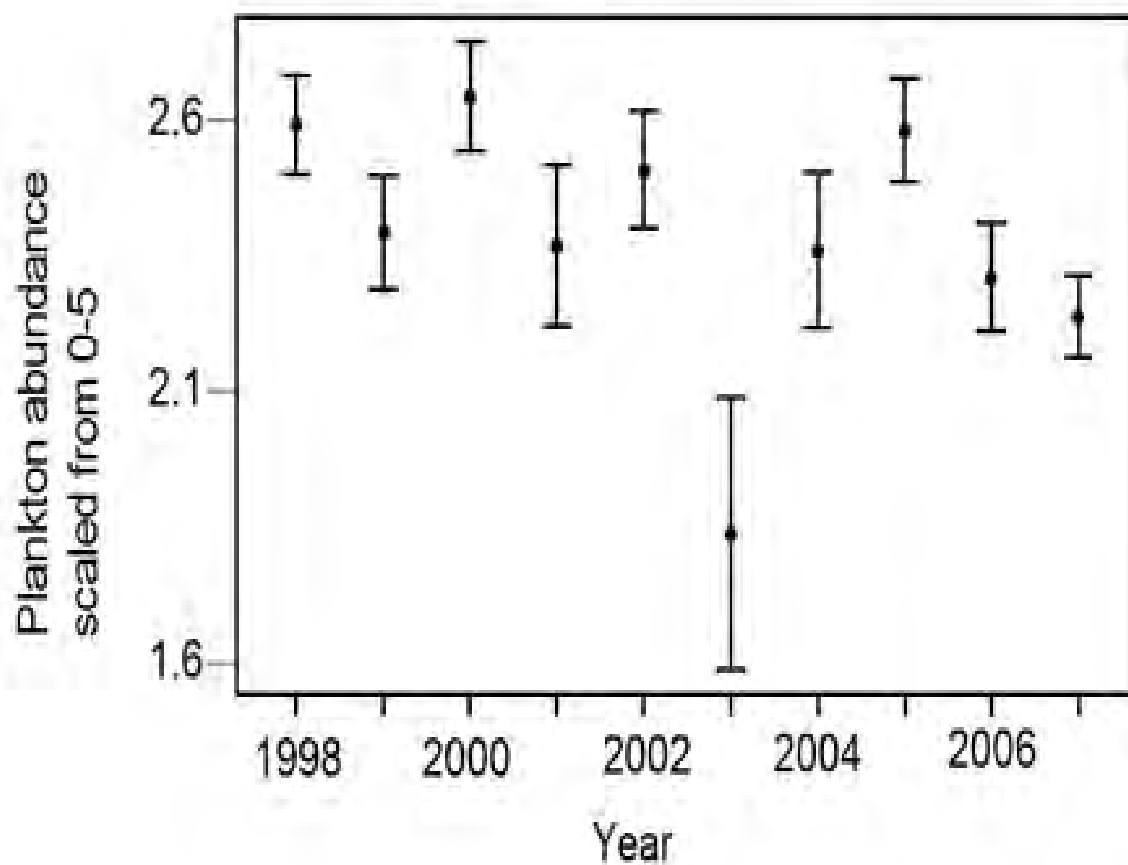
- Of the top species captured in surface tows during the day, not one was a species with an average number of 1 or greater in emergence nets.
- In night time tows, the top species captured in surface tows *Labidocera* spp. adult males and females – which was the most abundant species in emergence nets



# Where is the manta diet coming from?

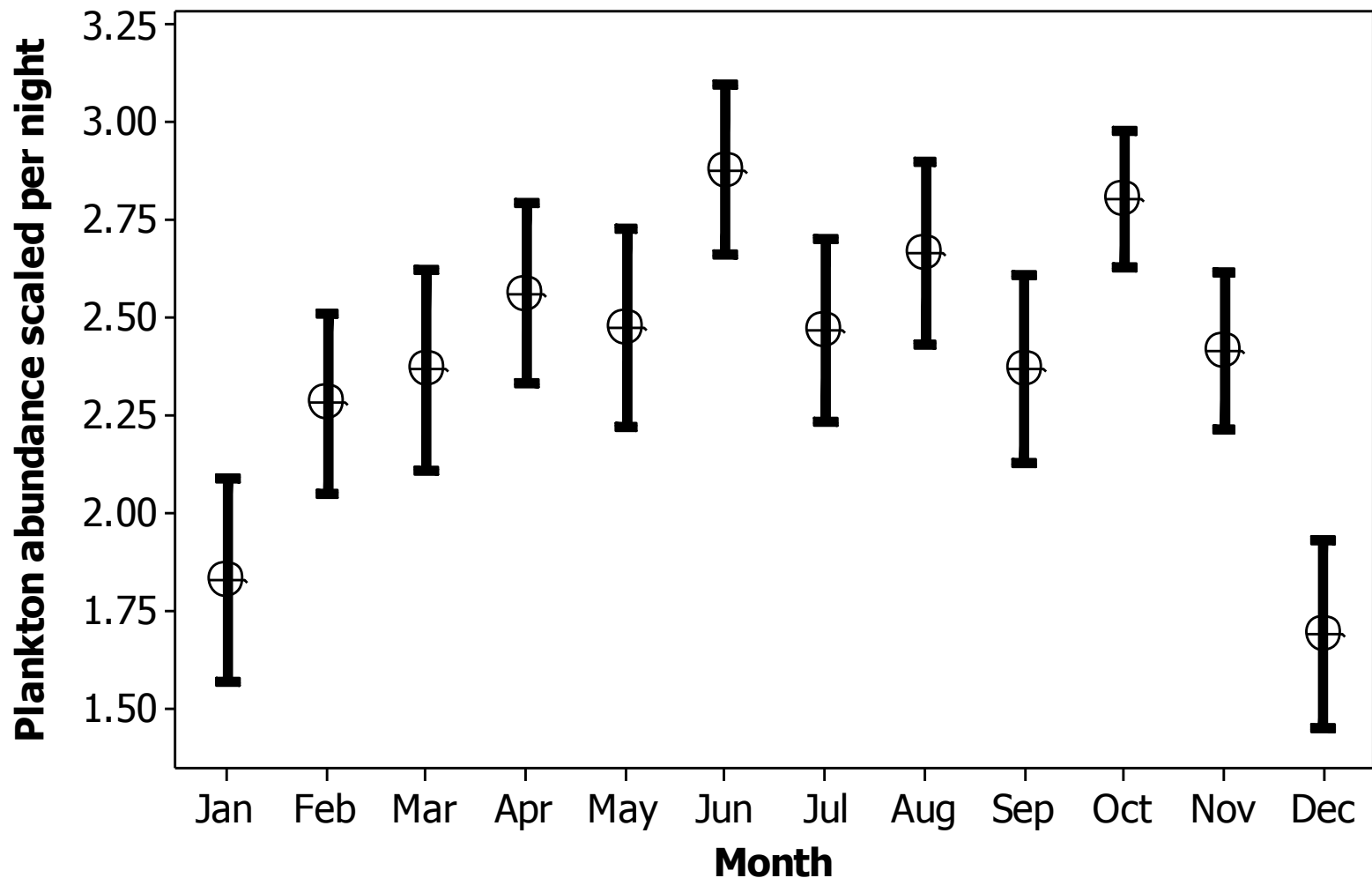
- Overall comparisons of the day and night surface and vertical tows indicate that dominate species retained within emergence nets were not in the water column, or in very low numbers in the water column prior to nightfall.
- Thus the dominate species within the water column after dark within Makako or Hoona Bay originate from the substrate, not the water column.

# Long term changes in zooplankton

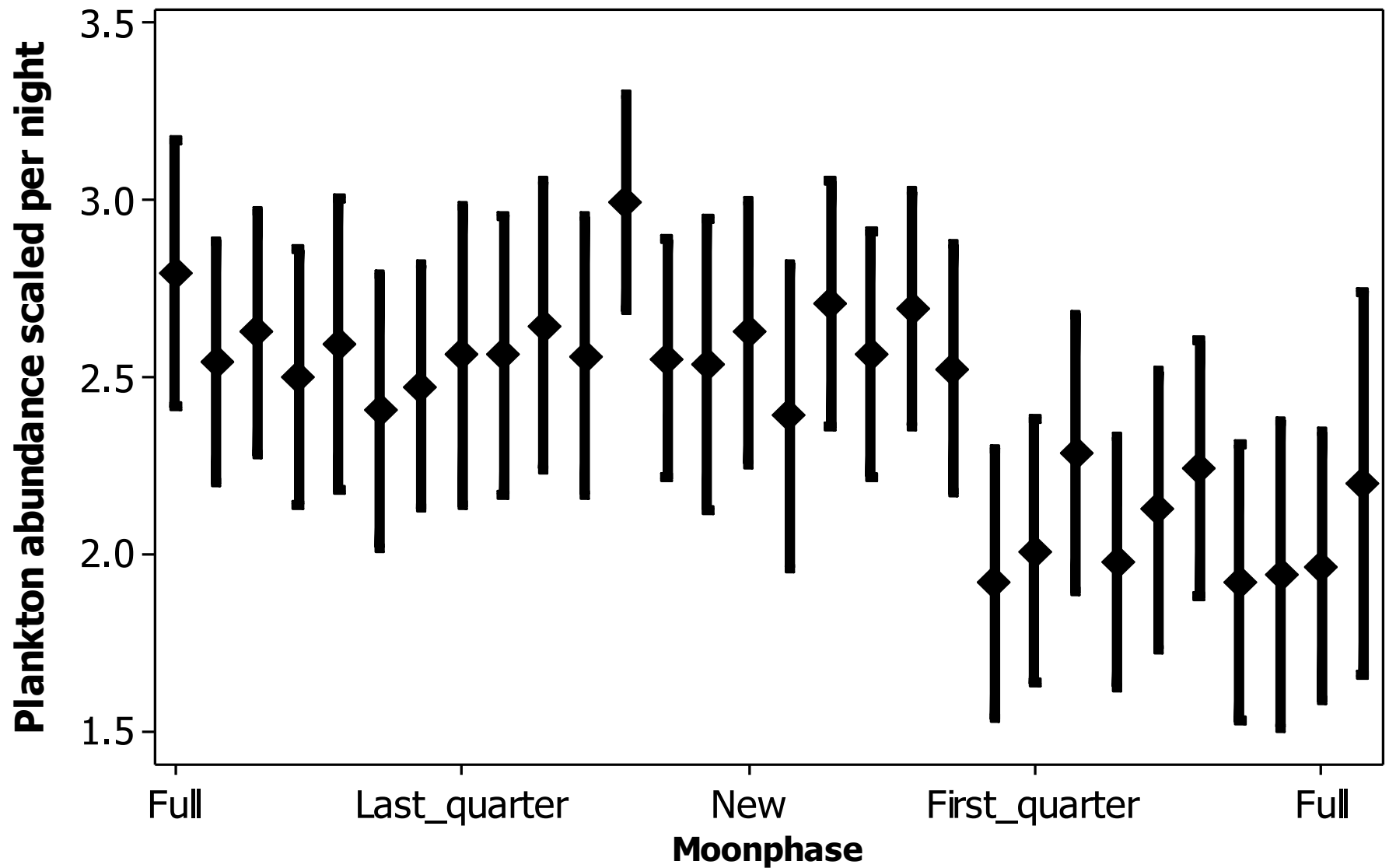




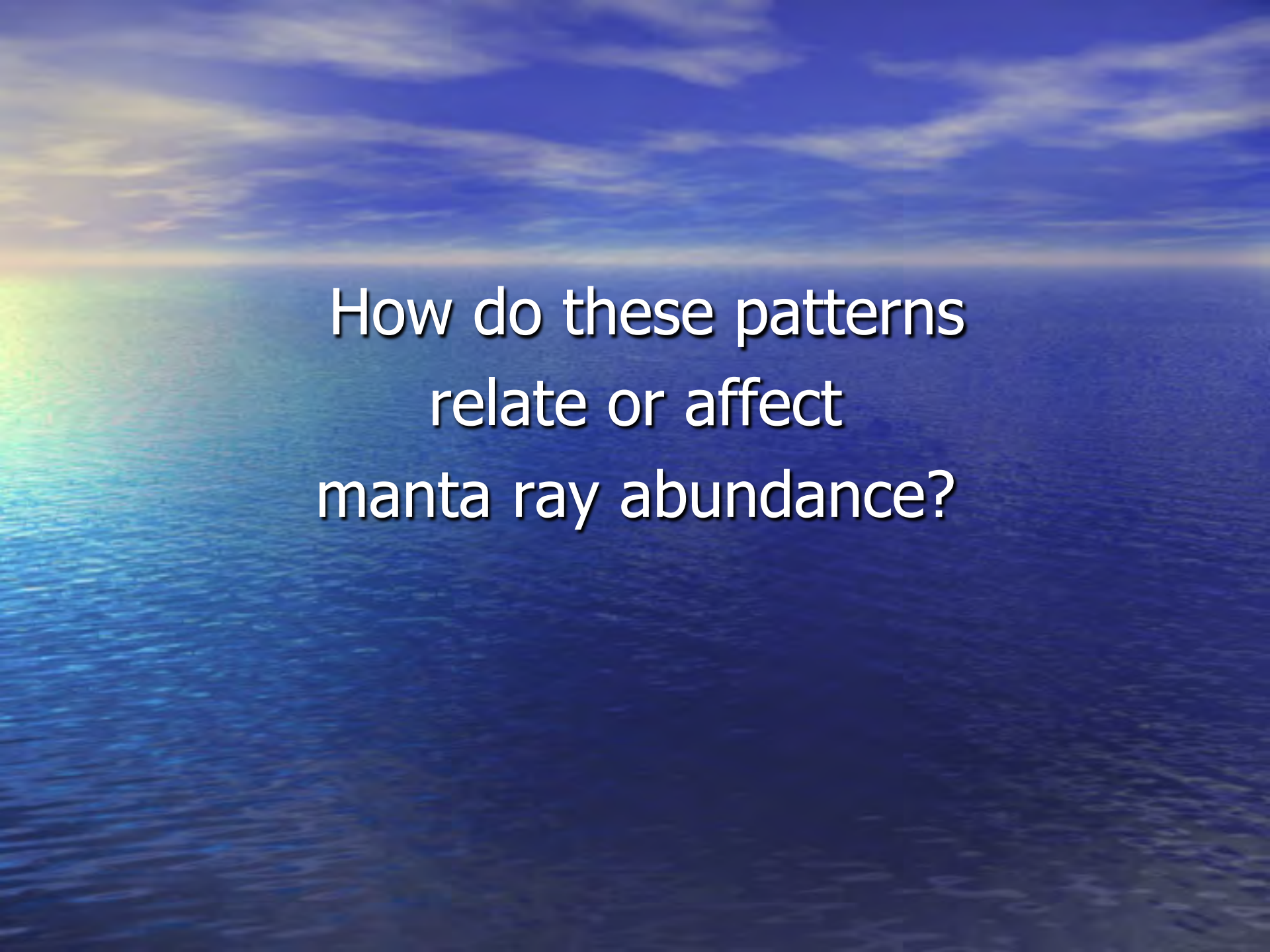
# Zooplankton long term data over the year



# Long term to lunar cycle

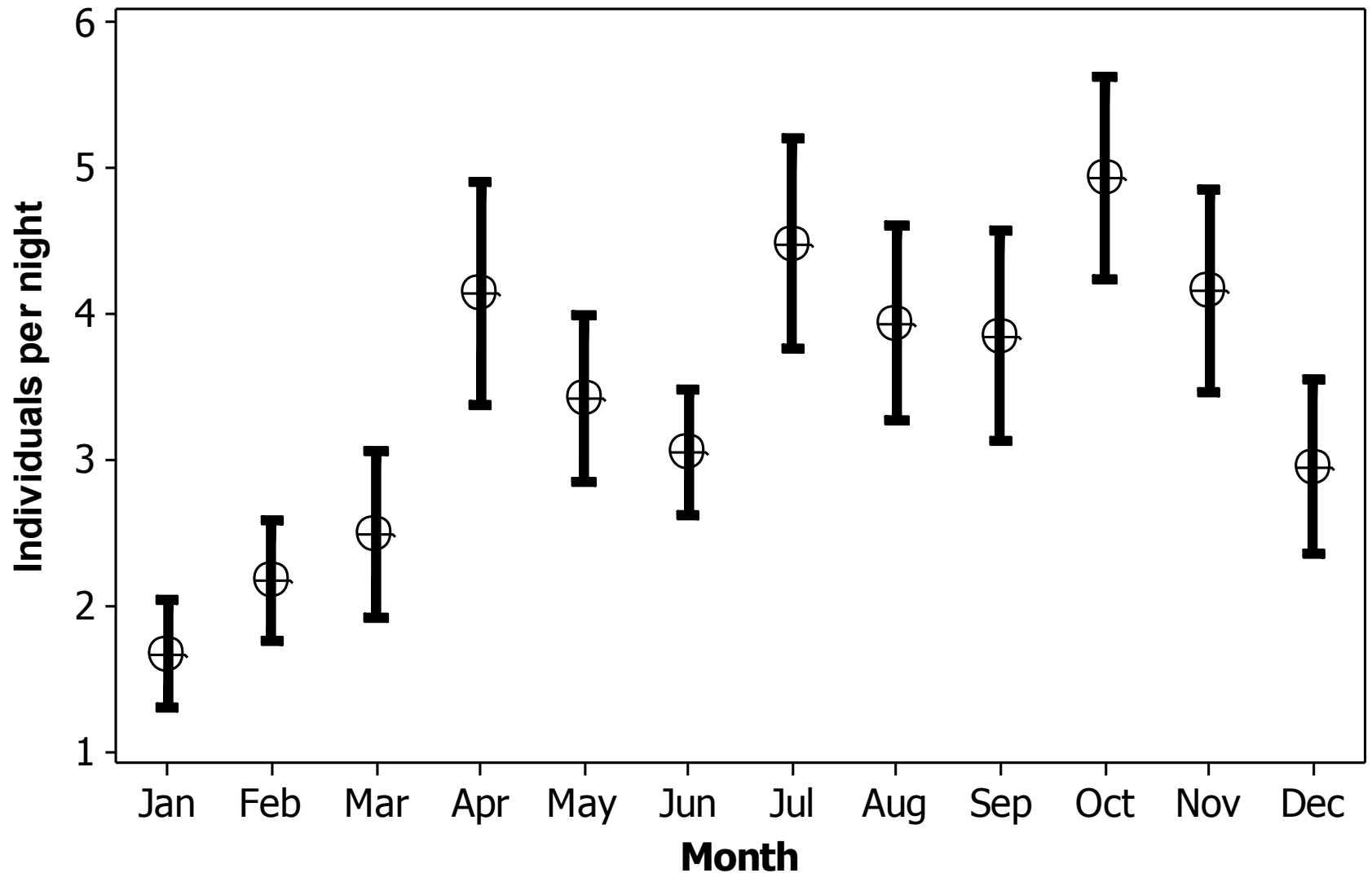






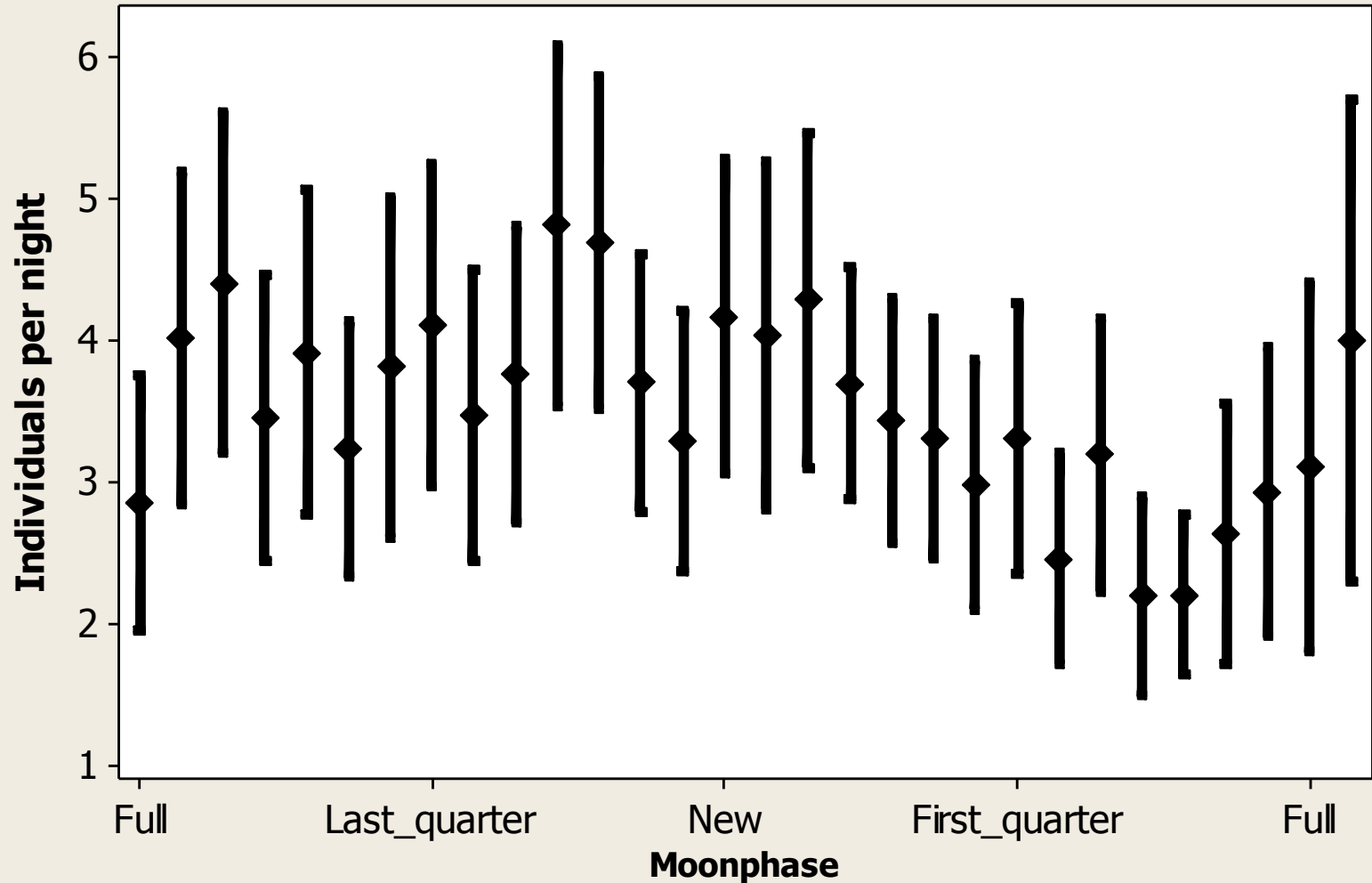
How do these patterns  
relate or affect  
manta ray abundance?

# Manta rays seasonal annual cycle





# Manta ray abundance to lunar cycle



# Zooplankton and Manta Rays

- The highest density of plankton was recorded on the 12th day after the new moon
- High numbers of manta rays were also observed on the 11th and 12th days
- As with manta abundance data, low levels of plankton were recorded around the second quarter moon
- Spearman Rank Correlation results for manta ray abundance to zooplankton showed a positive correlation between manta ray numbers and zooplankton (0.331, P-value = 0.000).



# Current Efforts

- Through support of NOAA, UH-Manoa and CORAL current research and work the community is underway to look at possible management of the site along with social dynamic assessments of the user groups.
- Meetings 28<sup>th</sup> of June 2011

# Meeting results – the Good!

- A feeling that site is more organized than before, boards and rings helpful for safety
- Increased awareness by participants, tourists
- Manta Pacific Standards limited touching and riding
- Large economic force for community



# Meeting results – needing change

- Not ideal communication
- Needs site organization rather than individual operators
- Experience diminished (more like Maui cattle boats)
- People with no lights is a dangerous safety concern, especially independent people
- Concerns impacts on reefs with so many divers at one or 2 spots
- Anchoring
- Community does not think environment is ready for more growth at sites
- Garden eel cove environment has taken a beating – coral decline; could be linked to storms and swells

# Meeting results cont.

- Getting large mantas pulled away from site by snorkeler lights
- Concern people coming from outside are not getting briefing
- Crowding: 80+ snorkelers bumping each other
- Number of snorkelers is increasing
- Worry about number of snorkelers
- Physical concentration of boats and bodies
- Crowding gives activity a bad name
- Economic downturn means more demand for snorkeling, don't need experience
- Site at tipping point, stressfulness of site increase



# Next steps the groups wanted

- Would we police ourselves if we agreed to limit the number of people and volunteer five nights per company?
- A need for permits – boats/people
- Needs to be enforceable
- Need a facilitator
- Quarterly manta community forum for suggestions on improvements
- Snorkel leader training for safety of people and mantas (same for dive guides) for keeping consistent and current with standards
- Something included in DOBOR permit process for education at dive sites
- Develop standards
- Give an exam to be a guide

# Next steps Cont.

- *Dive shop owners and snorkel leaders need training/ certification*
- Fear involving government taking management out of control of community
- Manta pacific and CORAL could host and find facilitator for process
- Confliction about government, worry that voluntary agreement won' t be enough
- West Hawaii Fisheries County is a recommendation board, but concern about enforceability
- Way to cap it at current numbers? Give permits to people currently operating to limit more growth?
  - With caveat that violation of community rules/ standards risks losing permit
- Is there a way to reduce numbers over time?



# What' s Next?

- Emma Anders
- More meetings?
- Online submission forum?

# Special Thanks

- Advisors
- Special Thanks
  - Dr. Michael Parsons (main advisor)
    - Florida Gulf Coast University
  - Dr. Marta deMaintenon
    - University of Hawaii Hilo
  - Dr. Bill Walsh
    - Division of Aquatic Resources
- Special Thanks
  - Matthew D'Avella – wonderfully supportive husband
  - Richard Osada – research assistant and father
  - As well as my mother Bev Osada and sister Krsyta



# Special Thanks

- Research assistance and editors

- Paula Ayotte
- Josh Ballauer
- Brent Carman
- Steve Cotton

- Nan Howell
- Vicky Newman
- Chelsie Settlemier
- Kosta Stamoulis
- Darla White

## Meeting assistnace

- Emma Anders
- Laura Richmand



QUESTIONS?

